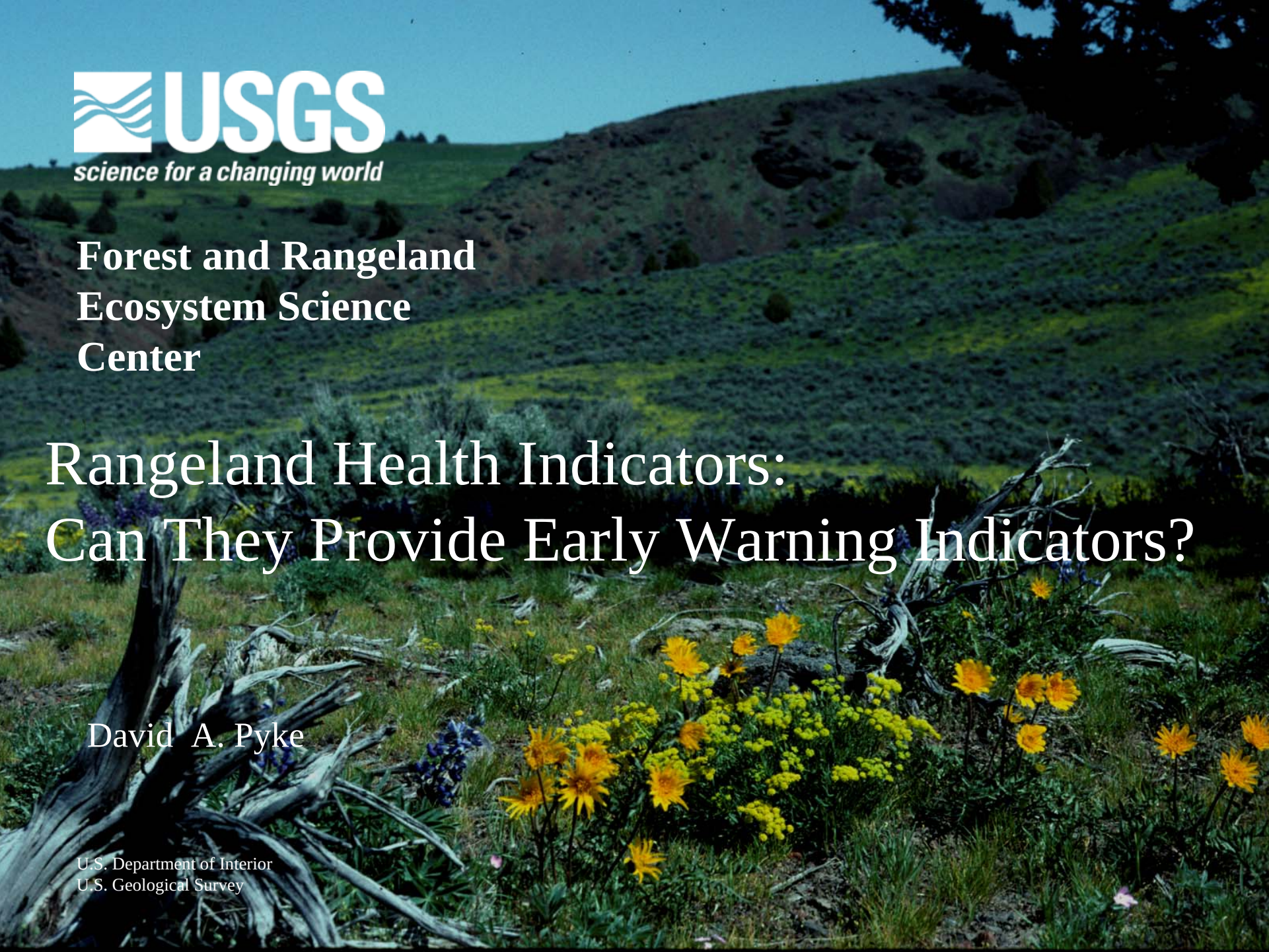

Forest and Rangeland Ecosystem Science Center

Rangeland Health Indicators: Can They Provide Early Warning Indicators?

David A. Pyke

U.S. Department of Interior
U.S. Geological Survey

Trajectory!

- Operational Framework
  - S&T models
    - Triggers/Drivers
    - Thresholds
    - Transitions
  - Assessment Tools
  - Monitoring Tools
  - Science & Mgmt
  - Application

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Sustainable Management of Ecosystems & Uses

- Sustainable uses require functioning ecosystems.
- Which require knowledge of sustainable levels of use.
- Which requires an ability to accurately predict degradation.
- Predictions direct management away from degradation

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Disastrous Decisions

Collapse: How Societies Choose to Fail or Succeed
Jared Diamond

- Failed to anticipate the problem
  - No prior experience
- Failed to perceive the problem that exists
  - Nutrient loss with no knowledge of nutrient cycle
- Failed to attempt to solve the problem
  - Selfish behavior

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Anticipate the Problem

- Recognize the signs of pending problem
- Experienced this problem before
- Understand potential consequences
- Take corrective actions to prevent problem

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How Do We Perceive Problems?

- Understanding:
  - The Ecosystem
  - The Uses & how they can change the system
  - Recognize the progression of changes
  - Assess the system relative to potential changes
  - Track the status over time.

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Knowledge of Ecosystem Dynamics

- Biotic community potential depends on:
  - Climate
    - Growing Seasons = f(Temp + Precip + Timing)
  - Soil
    - Soil = f(parent material + organic inputs + water + time)
  - Disturbances
    - Biotic – consumption, trampling, excavation, fire
    - Abiotic – Wet *vs.* Dry, Heat *vs.* Cold, Floods, Fire

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Dynamic Framework

- Ecological Site Description
  - Soils & Climate relative to Plant Community
  - Plant Community Dynamics (S&T Models)
    - Reference & Alternative States
  - Potential uses
  - Potential problems
  - Reference descriptors of Rangeland Health Indicators

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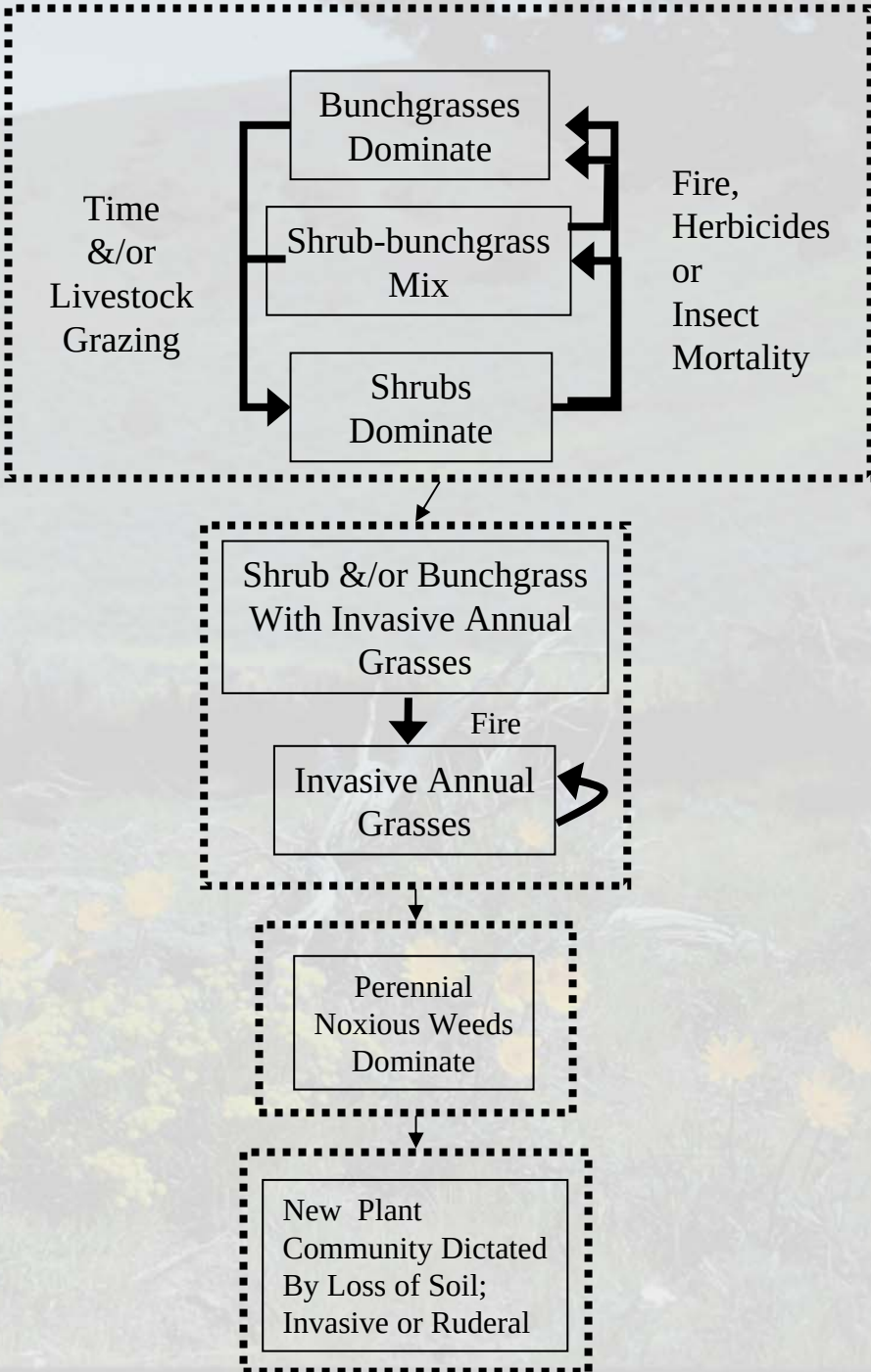
States, Thresholds & Transitions

- States – Relatively stable & resilient
- Thresholds – Tipping points btwn States
- Transitions – Changes btwn States relatively irreversible.



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Cost of Conversion

	Current community		
Desired community	Reference state	Intermediate state	Degraded state
Reference state	Low	High	Very high
Intermediate state	Low	Low	High
Degraded state	Low	Low	Low

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What Drives or Triggers Change?

- Biotic or abiotic forces
  - Herbivory
  - Fire or lack
  - Climate
  - Flood or lack
  - Plant invasions
  - Restoration & Rehabilitation

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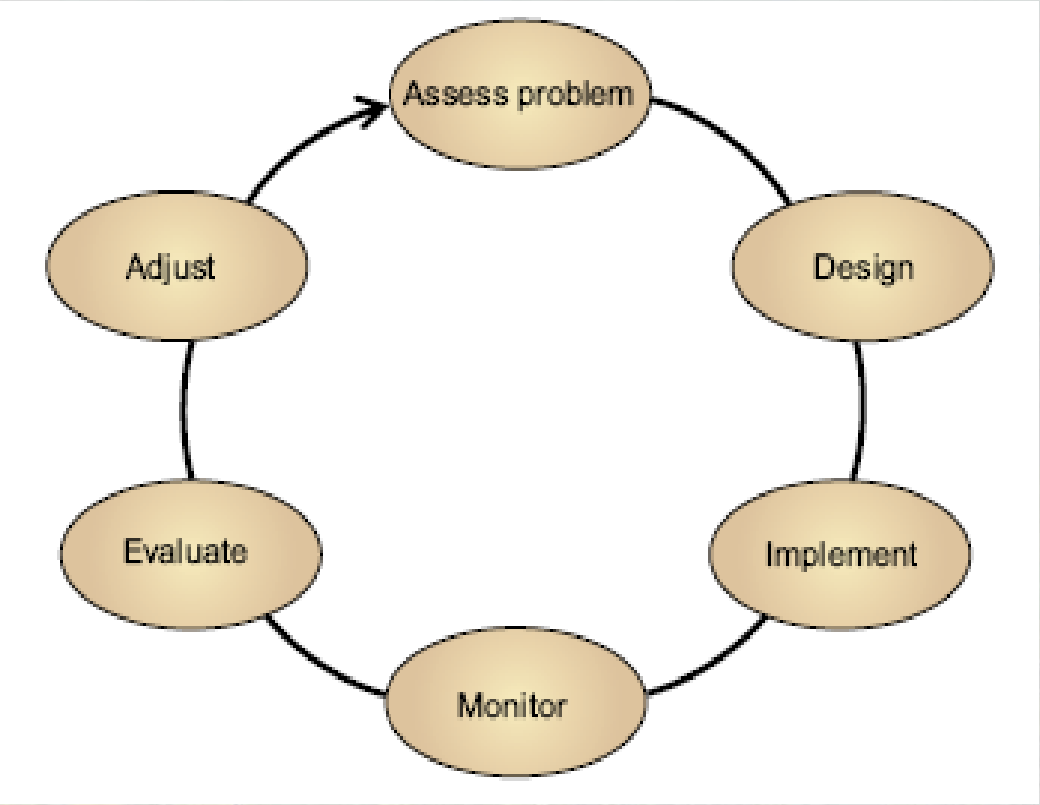
Tools for Detecting Problems & Tracking Solutions

- S & T Models
- Assessments
- Monitoring
- Management Science



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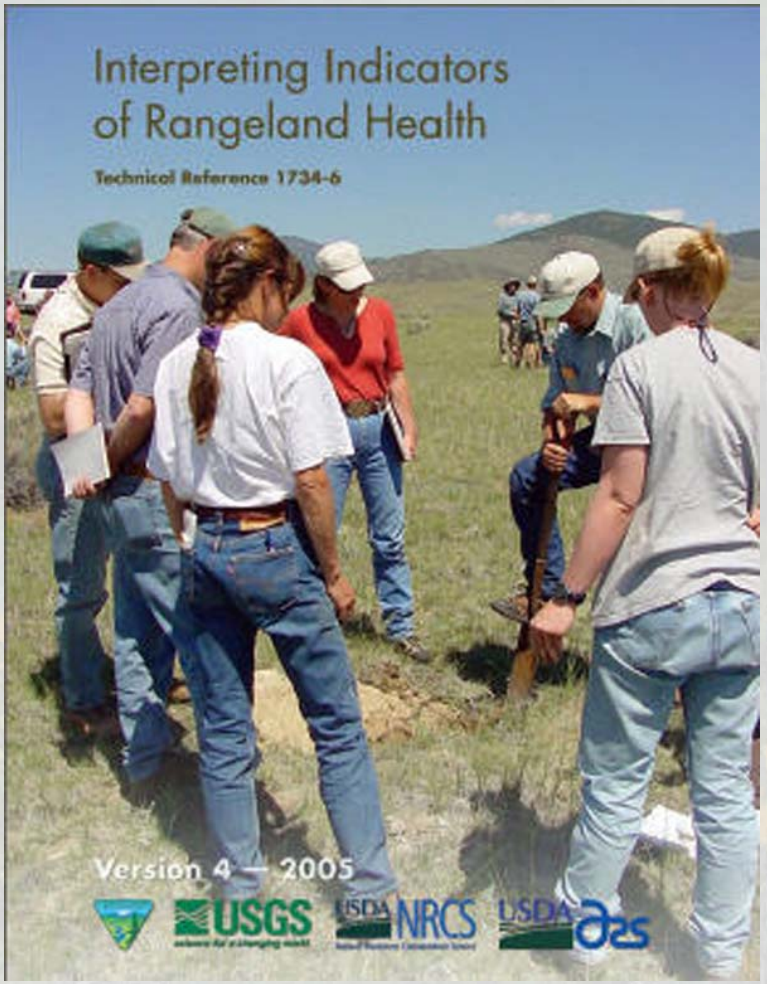
Rangeland Health & Early Warnings

- Qualitative Assessment – Interpreting Indicators of RH
  - 3 Attributes – Soil stability; hydrologic function & biotic integrity
    - 17 Indicators
    - 5 rating categories
      - None to Complete deviations



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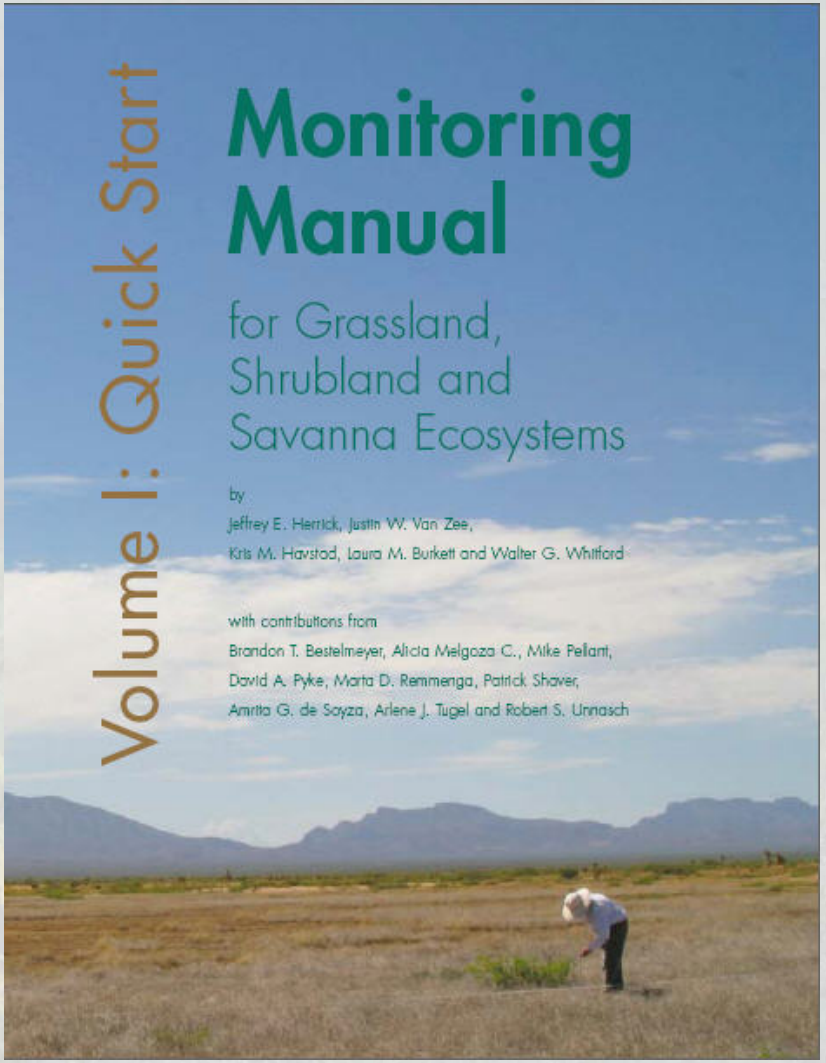
Rangeland Health & Early Warnings

- Quantitative Monitoring
  - 3 Attributes
  - Plant (Life form) Cover/Composition
  - Plant Structural/Function
  - Spatial gaps among plants
  - Soil aggregate stability



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Assessment Warnings

- Any Attributes with Moderate deviations or larger from expected
- Key indicators that relate directly to Alternative States
  - Invasive Species
  - Bare ground
  - Structural/Functional Groups
  - Soil Aggregate Stability
- Cautions – No trend info

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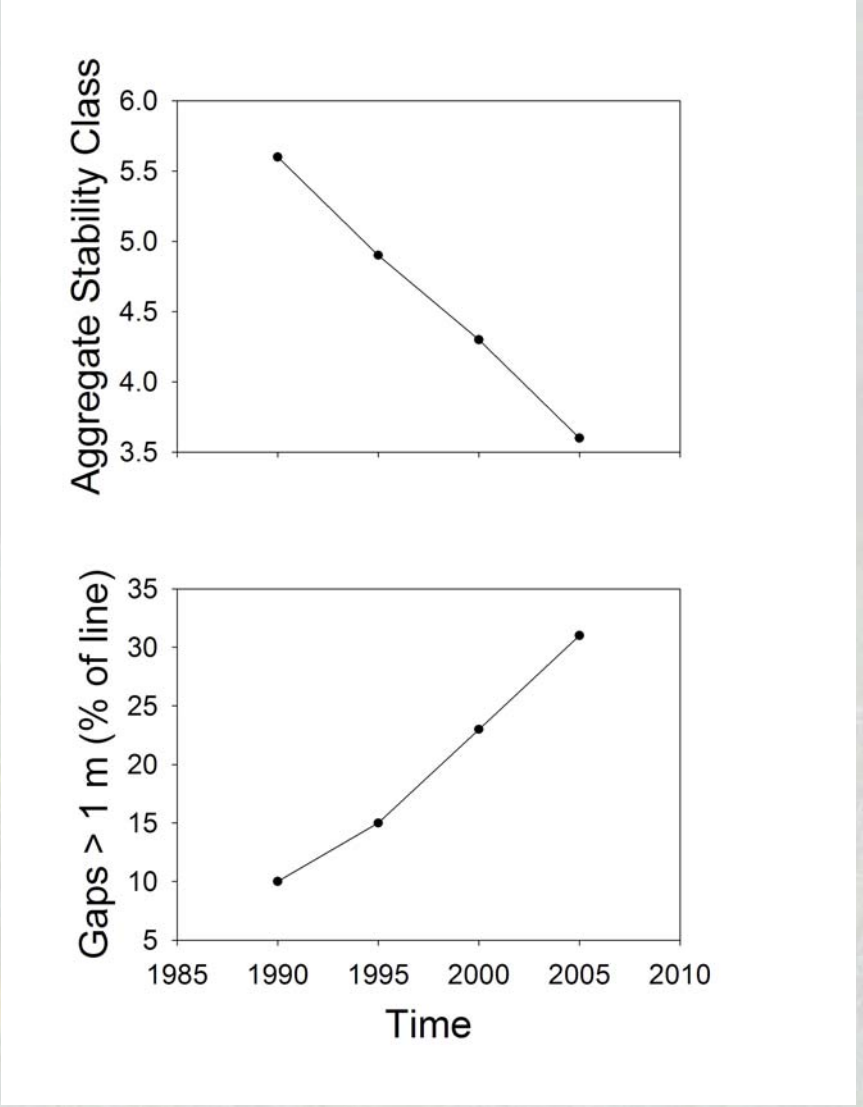
Monitoring Warnings

- Changes over time
- Losses of life forms or species
- Increases in unexpected life forms
- Increases in bare soil
- Losses of aggregate stability
- Increases in % of large gaps



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Monitoring Triggers (Drivers) of Change

- Livestock Use
  - Actual Use
  - Season of Use
- Recreation Uses
  - Trails & Tracks
- Road Developments
- Oil, Gas, Mineral developments
- Climate

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Trigger or Driver Indicators

- Short-term Indicators
  - Responses that reflect the impact of Triggers or Drivers on resources
  - Should be related to long-term indicators.
- Examples
  - Livestock
    - Utilization & Stubble Height
  - OHV
    - Track km/ha

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Long-term Response Indicators

- Reflect changes in biotic and abiotic resources due to Triggers or Drivers
- Tied directly to ecological processes
- Measurable indicators of trends in ecosystem status
- Measures biotic/abiotic responses
  - Often relating Trigger to S&T alternative states
- Used for making management changes

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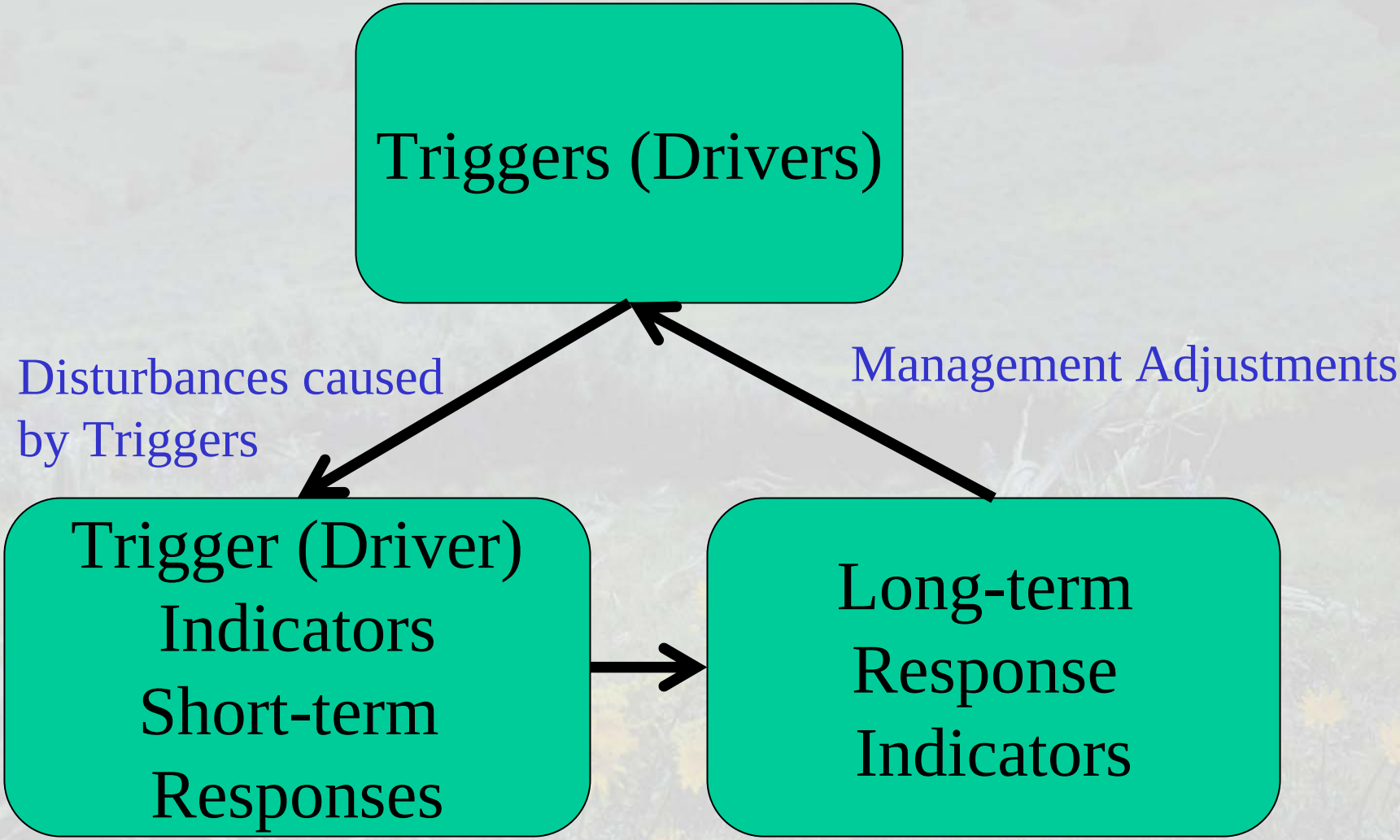
Early Warnings Detected



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Early Warnings Missed

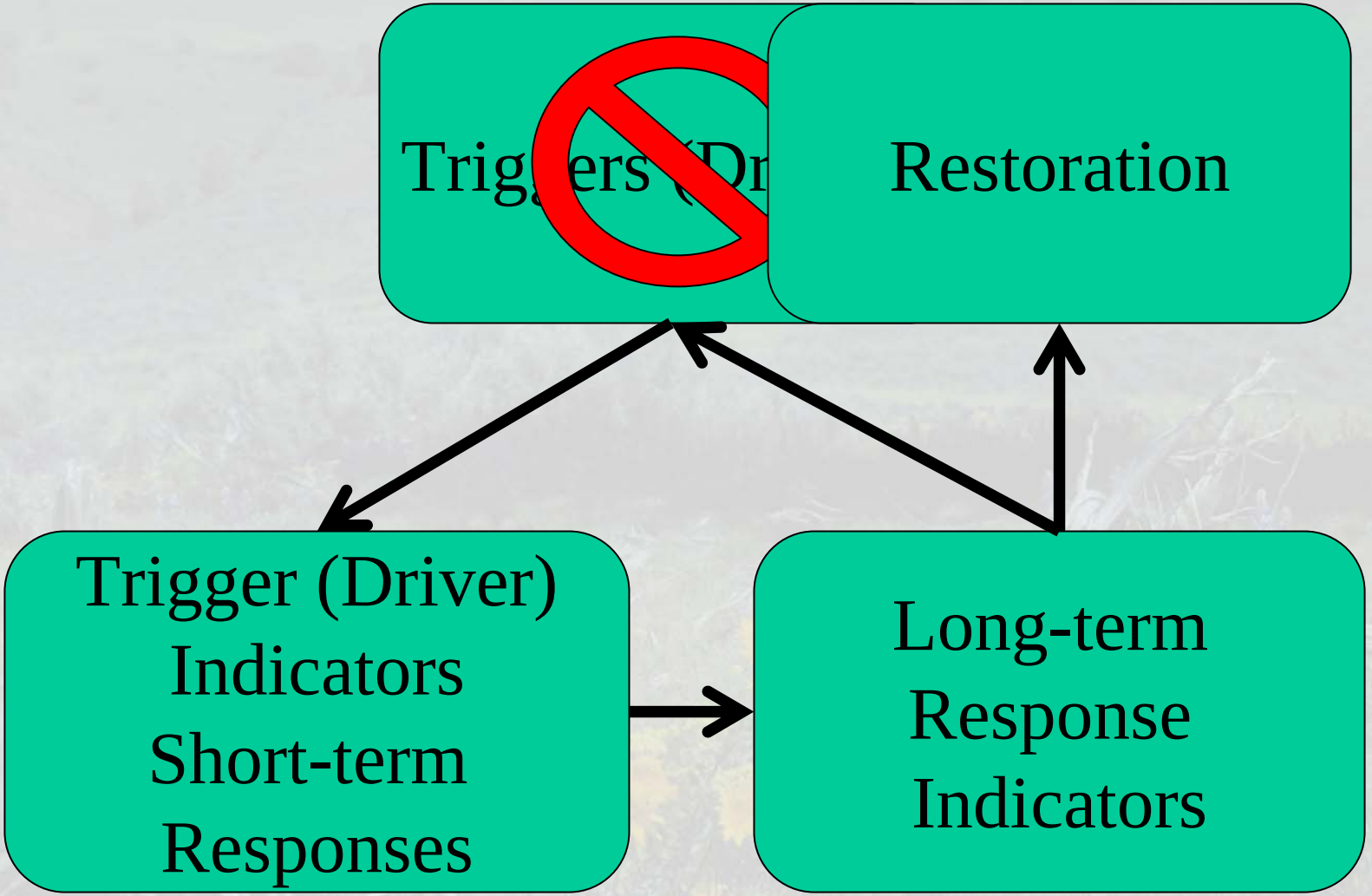

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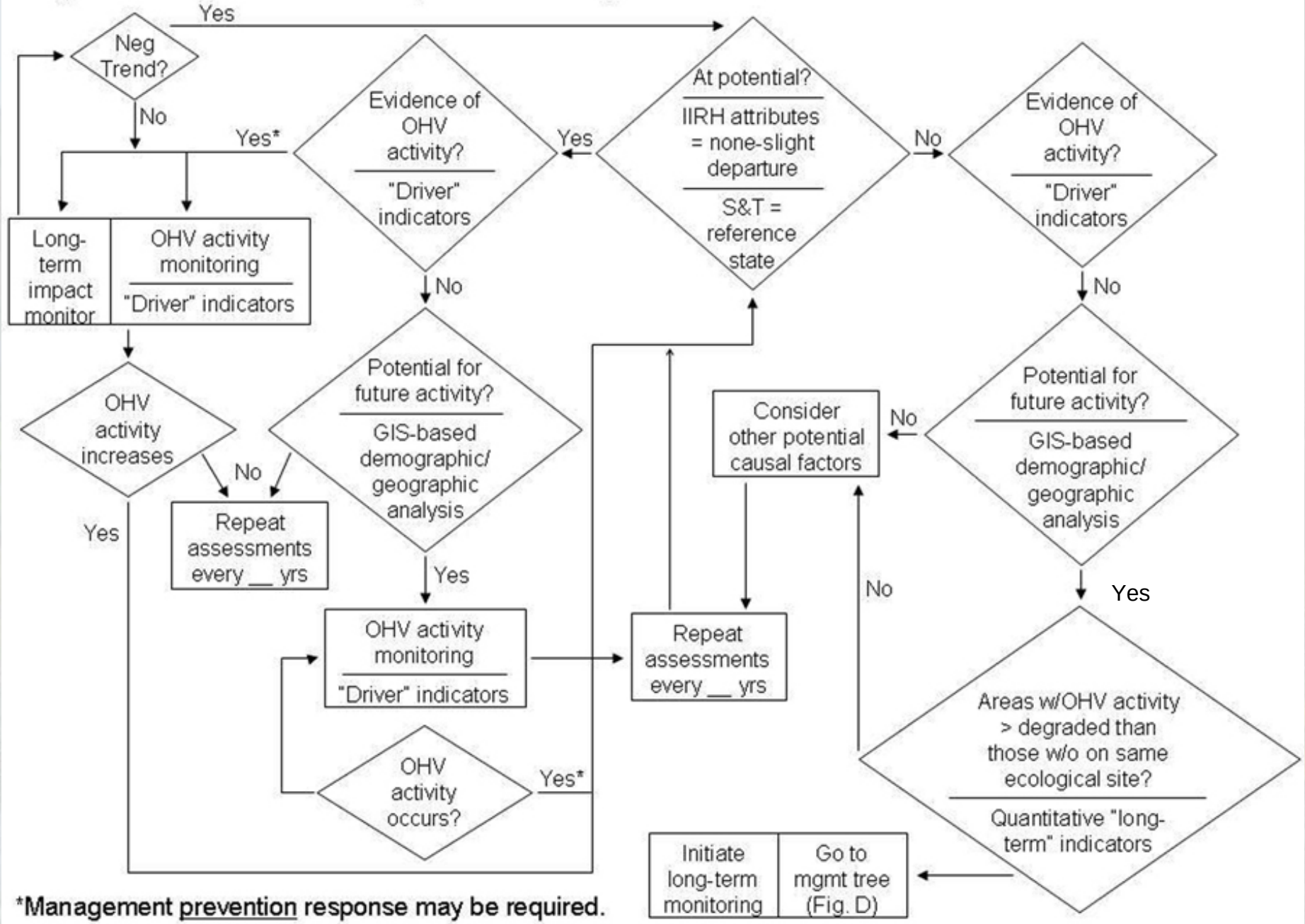
Figure C. Assessment component example.



*Management prevention response may be required.

Summary

- Early warnings avert disastrous decisions
- S & T models alert managers of thresholds & alternative states
- IIRH can assess status of ecological processes
- Quantitative monitoring validates status & with time gives trend
- Decision support is needed to weigh alternative management decisions

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